

Multispectral imaging for detection of grain vitality

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Introduction

In seed production, malting, and brewing the germination properties such as vitality and germination index of grain batches as well as starch modification and water distribution in the single grain during germination, are important quality parameters. These properties are linking directly to the economic value and applicability of the individual grain batch and are traditionally quantified by performing the actual germination process on a small sub sample from each batch. In addition to problems with sub sampling not being representative of the complete batch comes the problem that these germination tests may take up to a week to perform, which means that the release of the grain batch is delayed.

The purpose of the work presented here is to investigate the potential of automating and speeding up the process of determining the germination properties of grain.

Materials and methods

A sub sample (100 grains) of a batch of barley (cv. Class) was placed on filter paper in a Petri dish. The filter paper was linked to a wick immersed in water in order to provide unlimited access to moisture during the experiment.

The sample was placed under a VideometerLab 2 instrument capturing multispectral images at discrete wavelengths in the UV/VIS/NIR range from 370 to 1050 nm. Images were captured automatically every two hours over a period of 72 hours. The temperature was kept constant at 25 ± 2 °C. The sample was kept in darkness, except for during the image capture (approx. 6 seconds multispectral image).

Four other sub samples were analysed by the reference method, based on counting the number of grains sprouting roots after 0, 24, 48, and 72 hours (EBC Analysis Committee, 1998).

Results and discussion

The initial data analysis showed that images captured at 505 nm (green) were best for detecting germination (in terms of a sprout appearing) from the multispectral images. Selected images captured at 505 nm are shown in Figures 1A and 1B. The number of germinated grains was counted at each time point. Counting had to be stopped after 44 hours due to overlapping of the germinated grains.

The observed germination percentages from the multispectral imaging method and the reference method are shown in Figure 2. Due to the automation of the imaging method more data points are available and the rapid increase in the germination percentage (after 10 hours) is better described by this method. At the other end of the curve the reference method is better defined since it is not affected by the overlapping of the grains. This problem is, however, easily solved by keeping the grains separate from the beginning of the experiment with the imaging instrument.

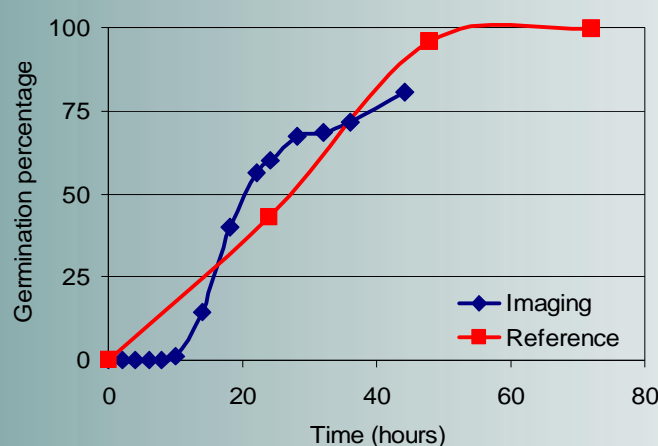


Figure 2: Germination percentage as recorded at 505 nm by imaging and by the reference method.

Conclusions

The work presented here shows that it is an advantage to use imaging at specific wavelengths for monitoring the germination of grain samples. The fact that the method can be automated means that the germination process can be monitored more frequently (instead of only at 0, 24, 48, and 72 hours) and thus give a deeper insight into the mechanisms. Potentially, this means that it may not be required to monitor to process for a total of 72 hours.

Future studies

Our future work will focus on improving the multispectral imaging method in order to extract more information from the images:

- Use of NIR wavelengths for studying the water intake into the kernel looking at external traces.
- Use of NIR wavelengths for internal traces such as water diffusion or starch modification.
- Further automation of the method to allow for fast and accurate simultaneous measurement of multiple samples.

Reference

EBC Analysis Committee. 1998. Analytica-EBC. Hans Carl Getranke-Fachverlag, Nürnberg, Germany.



Figure 1A: Images captured at 505 nm after 0, 4, 8, 10, 14, and 18 hours (top to bottom).

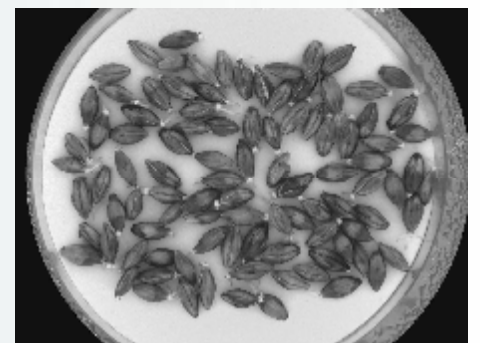
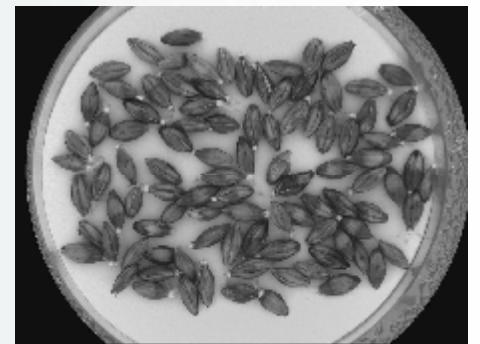


Figure 1B: Images captured at 505 nm after 22, 24, 28, 36, 52, and 68 hours (top to bottom).